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ABSTRACT

This paper explores some of the work that has been occasioned by the writings of D.A. Schon on the development of professional knowledge by teachers. The paper has four sections. The first is a sketch of one interpretation of Schon's theoretical approach. The second examines selected appraisals of the more general features of Schon's work. The third section focuses on his two concepts of reflection which seem to have been misinterpreted by some who use his work. The fourth section focuses on the concept of "reframing", which is taken to be central to Schon's account of the development of professional knowledge. The discussion moves toward identifying theoretical and empirical questions that have been raised, and by the appraisals noted in the second section. The paper's responses to these appraisals is the starting point for speculations about the directions that might be taken to further understanding of the conditions that promote teachers' professional knowledge. Thirty-five references are included. (JD)

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REFLECTION-IN-ACTION AND REFLECTION-ON-ACTION[1]

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Introduction

Since the publication of Schön's (1983) book on the character and development of professional knowledge, our research has been directed at applying his theoretical position to the problem of how teachers acquire the knowledge of practice that allows them to teach as they do.[2] Briefly, we have attempted to understand what lies behind the apparently simple notion that teachers learn to teach by teaching, by examining how teachers interact with their experiences in order to learn from them. This paper does not dwell on the results of our qualitative case studies of 13 participating teachers; these are reported elsewhere (Russell, 1988; Russell, Munby, Spafford, & Johnston, 1988). Instead, this paper explores some of the work that has been occasioned by Schön's writing. As shown below, his books have been interpreted variously, as different people have found different points to focus upon. In some cases, these differences suggest that there are difficulties in Schön's position; in other cases, there are grounds for thinking that the differences emerge from incomplete understandings of Schön's position. We find that discussing the various interpretations helps to push our own thinking forward, and to identify the questions that we find worth pursuing.

The paper has four sections. The first is a sketch of our interpretation of Schön's theoretical approach. The second examines selected appraisals of the more general features of Schön's work. The third section focuses on his two concepts of reflection which seem to have been misinterpreted by some who use his work. The fourth section focuses on the concept of "reframing," which we take to be central to Schön's account of the development of professional knowledge. Here, the discussion moves toward identifying theoretical and empirical questions that are raised by our own work and by the appraisals noted in the second section. The paper's response to these appraisals is the starting point for speculations about the directions that might be taken to further our understanding of the conditions that promote teachers' professional knowledge.

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[2] The most recent study is "Metaphor, Reflection, and Teachers' Professional Knowledge", directed by Hugh Munby and Tom Russell, and funded by the Social Sciences and Humanities Research Council of Canada, 1986-1988. Sandra Cantelon, Yang Chang, Phyllis Johnston, and Charlotte Spafford have assisted in this work. The use of the first person plural in the paper refers to the project's collective work, although I take responsibility for the position developed here. Preparation of this paper was assisted by a grant from the School of Graduate Studies and Research, Queen's University. (Inquiries may be sent to Munbyh@QUCDN or Russellt@QUCDN.)

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Salient Features of Schön's Approach

Schön's two books (1983, 1987) advance the position that there is a fundamentally important aspect to the knowledge possessed by professionals that has been overlooked. Initially, he develops his case by arguing that our academic institutions place undue emphasis upon "technical rationality"--the disciplines of knowledge and the methods that are believed to make formal, propositional knowledge reliable and valid. Our society's emphasis upon technical rationality, Schön argues, has led to an undervaluing of the practical knowledge of action that is central to the work of practitioners. This form of knowledge, which he calls "knowing-in-action," is the practical knowledge that professionals hold about their professional work and that cannot be formulated in propositional terms. By exploring the elements of knowing-in-action, Schön demonstrates that professional knowledge itself has been virtually unrecognized because it appears not to be as "rigorous" as knowledge developed in the more familiar and public "scientific" research traditions. In his argument, Schön proposes a fundamental reorganization of how to think about professional practice and the relationship of theory to practice. For Schön, professional knowledge is developed *within* action, just as it is articulated within action. The concept "reflection-in-action" is invoked to refer to the active and non-propositional processes by which new knowing-in-action is developed--a matter to which the paper returns later.

Schön elaborates his position in his second book (1987), with special attention to what he calls "the reflective practicum"--the specific experiences that he believes help students to acquire knowing-in-action under the coaching of expert practitioners. In a later piece, Schön (1988) addresses what he means by reflective teaching--"giving the kids reason"--and argues for a reflective supervision that might help teachers become more reflective-in-action.

Appraisals of Schön's General Approach

Schön's work has attracted the attention of teacher educators, and there are many papers that refer to his 1983 work, although, as shown below, the lineage is not always clear. Yet, as is quite proper, his approach has received criticism. For instance, his position is quite different from the position advanced by Fenstermacher (1986) that the thinking of teachers relies upon "practical arguments" containing premises based on research information. Several papers concerning this position appeared in a recent issue of *Educational Theory*. While Morine-Dershimer (1987) presents evidence that some teachers appear to use practical arguments, Buchmann (1987) challenges her assumptions. Both Munby (1987) and Russell (1987) demonstrate that practical arguments do not tell the whole story. Among our recent case studies there is evidence that teachers use research information, but they do not appear to adopt the information wholly as they might in a practical argument. Rather, they tend to assimilate the information and adapt it so that it changes a part of their professional knowledge. The case of "Diane" (Russell et al., 1988) speaks directly to this process.

Fenstermacher (1988) revises his position about practical arguments somewhat, arguing that they could function usefully as analytic devices in a reflective practicum, and could assist teachers in thinking about their teaching. But at the same time, Fenstermacher introduces other difficulties with the epistemology of practice. First, Fenstermacher argues that Schön is not constructing an epistemology of practice, if epistemology is understood to be concerned with an examination of evidence, knowledge and belief. Second, Fenstermacher worries that Schön's account runs the risk of separating practitioners from the products of the social and behavioral sciences.

The dichotomy between technical rationality and reflective practice is of concern to Shulman (1988) also. Part of his critique cautions against dichotomies in general, while the larger portion of his critique urges a closer connection between the work of Schön and that of other philosophers and psychologists of education: Herbart, Dewey, and Ausubel are among the names mentioned. Interestingly, Shulman (1987) has himself used dichotomies--several of them in the form of categories--to create a landscape of professional knowledge. "Reflection" and the "wisdom of practice" are two features in this landscape. To be sure, undue adherence to dichotomies is dangerous, but our language portrays phenomena in discrete bits and, since language is the basis of much of our theoretical work, dichotomies and categories are bound to be employed.

In their review of Schön's (1983) book, Clandinin and Connelly express some concern for the unclear nature of the "*kind* of inquiry proposed in reflection-in-action" (1986, p. 198). In another paper, while acknowledging some differences between Schön's reflection-in-action and Schwab's deliberation, Connelly and Clandinin (1986) find that "both terms name the method used in the act of thinking practically" (p. 294), and point out that the distinction between reflection-in-action and reflection-on-action "separates thinking during practice from thinking after or before" (p. 294). In both sources, Clandinin and Connelly express concern that Schön's approach still separates practice from its analysis through theory, and that it defines what is problematic in terms of problem formulation, very much as one might expect of a version of problem solving using a variant of the scientific method. Connelly and Clandinin (1988) present a similar interpretation in their recent book:

> Schön....argues that practice is essentially a sequence of problem solving episodes. Given that idea, he then shows how practitioners solve problems in practice. They may use theory, but they have no direct interest in it. Their purpose is to solve the problem that confronts them. (p. 95)

Clandinin and Connelly (1988) offer a different critique when they propose their narrative method for the study of curriculum. Here, they argue that Schön's concrete conception of the practical contributes to the reductionism and certainty of technical rationality, the very view that he argues against. For them, technical rationality and its reductionism constitute inappropriate perspectives for understanding practice: "Emotion, value, felt experiences with the world, memory and narrative explanation of one's past do not stand still in a way that allows for certainty" (p. 3).

Court (1988) finds that Schön's examples

> seem to illustrate several rather different kinds of "reflection-in-action" and most, upon examination, appear to involve *removing* oneself from the action in order to reflect. Thus the term "reflection-in-action" may not be appropriate. (p. 144)

Even when defined within the "action present," reflection-in-action remains unclear to her because the action present is unclear: it might describe an instance of teaching or a term of teaching a particular course. Court also finds Schön describing reflection-in-action as taking a momentary "time out" from the midst of action. So it is not surprising that she calls for a clearer definition of action from Schön.

Selman (1988) asks if an epistemology of practice is needed and wonders what kinds of issues cannot be addressed by a technical approach. His examination of several instances of practical learning lead to the conclusion:

> One of the ways of understanding professional (or other human) practices better is to conduct a careful examination for the purpose of making explicit the concepts, standards, and rules which constitute given practice. Rather than formulating a "new paradigm" which would overturn established views in one sweep, we could describe, criticize, and reconstruct our practices at a local level. (p. 191)

Reframing and Reflection-in-Action

Schön is working in a complex area, and so it is not surprising that he is read in different ways. In our view, it is hard to assess the force of the appraisals without considering the concept "reflection-in-action," which lies at the heart of Schön's view of how experience essentially teaches us. This is clarified by considering the place of this concept in his theory and by describing the approach that we have taken to exploring the power of the concept empirically.

Our research follows our interest in how teachers learn to teach; in particular, we are exploring what is being described when teachers and others say that they learn "by experience." In a sense, we take seriously the difference between "having an experience" and "the way in which an experience is had." We find that Schön's "epistemology of practice" has given us "a new level of discourse about professional practice" (Munby & Russell, 1989a, p. 75). We have worked extensively to elaborate the meaning of Schön's concept of "reflection-in- action" in the context of observing and interviewing teachers about their work. In the process, we have come to understand several features of this concept. The first of these is that its emphasis is upon "in-action," not the familiar sense of "reflection" that most would take the word to mean. Accordingly, where it is normal, indeed desirable, to deliberately review one's actions using customary logical rules, this is not what Schön means by reflection-in-action. Instead, he reserves the phrase "reflection-*on*-action" to capture such reasoning. It is useful to note that reflection-on-action can be expected to involve propositional knowledge, for Schön does not reject the place of syllogistic practical arguments in professional thinking. It is just that these do not function within reflection-*in*-action.

The next feature we have understood is that reflection-in-action does *not* refer to the contemporaneous monitoring of one's actions as one is attentive to feedback. Actions proceed, with relative success, because we are attentive to feedback; and, generally, the feedback is unsurprising.

The third and distinguishing feature is apparent when we consider "backtalk"--Schön's term for unexpected feedback. We find it useful to think of backtalk in the more familiar metaphors of being taken aback when a youngster "talks back," frequently to undermine our directions. Actions can do the same, and our response to these phenomena is what Schön intends by reflection-in-action. Backtalk presents us with puzzles and surprises, and it is precisely because the backtalk is surprising that we have to treat it differently from anticipated feedback. In Schön's account, new paths for resolving the puzzles of backtalk become available to us by reframing, or by "seeing" the puzzling phenomena as something else. This process is essentially nonlogical, and is one over which we have little control: it is not ordered, logical, or deliberate. The essence of reframing lies in "seeing" one thing as another, which is the reason for our studying changes in the metaphors that teachers use when they describe their professional practices. (Munby & Russell, 1989b)

Quite possibly, the idea of reframing is mysterious. The writings of Toulmin and Hanson help to remove part of the mystery. Toulmin (1953) argues that science is a way of seeing, so learning science is not a matter of using old inferences to examine new data, but of learning to see data in new ways. The special nature of this form of seeing differently is the focus of

Hanson's (1958) discussion of "observation." Readers will no doubt recall the intriguing puzzles presented in the reversible pictures (often found in psychology textbooks) that Hanson presents: the old woman and the young lady (p. 11), and the antelope and the bird (p. 13). Especially intriguing to us is the power of the processes that enable us to suddenly see data differently. For Gestalt psychologists, the processes are known as gestalt shifts; for Kuhn (1962) they represent paradigm shifts, in a much larger sense. For Schön, in the context of learning what is taught by experience, the process is reframing. At the root of all this is the idea that reframing alters the way in which the data are "seen," and this yields a straightforward distinction: the sort of thinking characterized by reflection-*on*-action involves bringing new thinking to bear upon unsurprising and given data; in contrast, the reframing central to reflection-*in*-action involves seeing quite differently the events of a puzzling practical problem.

We do not read Schön to be claiming that reflection-in-action is the sole source of professional knowledge, although it represents the process by which one can learn from experience. Reflection-on-action is powerful, and professionals undoubtedly use the knowledge of technical rationality in their work too. Schön's contribution is the language he gives us to recognize and so attend to an element of "learning from experience" that can easily be overlooked. And, judging by the appraisals summarized above, this danger is real.

We venture to say that these appraisals are fair as far as they go, but that they do not appear to have come to terms with the idea of reflection-in-action. Accordingly, we might reassure Fenstermacher that Schön is not rejecting the place and importance of practical arguments and syllogistic reasoning, even if we do not understand how the products of social science research are incorporated into professional practice. Equally, Clandinin and Connelly are right to find Schön speaking of a sort of scientific method: working out explanations and strategies is the character of reflection-*on*-action; and the new frames suggested by reflection-*in*-action have to be tested in new actions. Also, we would take issue with Connelly and Clandinin when they argue that Schön has contributed to the separation of the individual from his or her experience. We do not understand how reflection-in-action comes about, nor do we know the origins of new frames; but it is not unreasonable to suppose that new frames are connected with personal experiences and with the language that gives them life. Finally, it could be that Shulman's concern for Schön's dichotomy between knowing-in-action and technical rationality is misplaced. It seems to us that the significant epistemological dichotomy is between routine monitoring and reflection-in-action, or between a response to feedback and a response to backtalk.

None of this is to say that Schön's formulations are without problems. Court is correct in drawing attention to the ambiguity of the "action present." However, action is complex, and thought about action is itself action. So, one can experience reflection-in-action while reflecting-on-action, just so long as new frames suddenly put the data in a new light, and so offer paths towards solving puzzles of professional practice. Our review of Schön's work (Munby & Russell, 1989a) is not uncritical either. In particular, we have been concerned that there is no conceptual connection between reflection-in-action and the reflective practicum that Schön endorses. Presumably, the reflective practicum is designed to enhance reflection-in-action as well as reflection-on-action. But without a clearer view of the elements of experience that prompt reframing, and the elements of the person that contribute to productive reframing, we do not readily see how the reflective practicum functions.

Varying Accounts of Reflection

The previous discussion shows that reflection in Schön's theory is not a unitary concept. Rather, his theory extends from distinguishing two very different forms of reflection: reflection-on-action and reflection-in-action. As Shulman (1988) seems to be saying, there is

nothing particularly novel about the function and significance of deliberately bringing careful logic to one's action, and there are several recent accounts of this form of reflection. For instance, Shulman (1987) and Zeichner and Liston (1987) clearly refer to a deliberate consideration of one's action, whereas the reflection that Schön calls attention to is *in the action* and not in subsequent thinking about the action. However, while these renderings are clear, others are not. For instance, Schön is cited as backing for a study of the reflective capabilities of cooperating teachers (Olson & Carter, 1988), in which reflection-in-action and reflection-on-action are not differentiated. The same point is pertinent to Calderhead's (1988) position, too.

It is difficult to interpret Schön without heeding the distinction between reflection-in-action and reflection-on-action. Gilliss (1988) rejects the applicability of Schön's work to teachers and school administrators on the following grounds:

> If any reflection is to take place, it must either be lightning fast, or the frequency of unusual events is much lower than Schön suggests....As pointed out earlier, teachers and administrators do sometimes reflect, reframe problems, and invent solutions. However, they are not in a position to make these occasions their normal *modus operandi*. Much of what happens must simply follow general routines. Life is too short to allow reflection on every occurrence. (p. 52)

Schön, in our view, is not making the claim that reflection-in-action is a frequent event. But he does argue that it is a process outside of our control: it is not the sort of thing one can switch on or off. For school administrators, the important question is whether the school environment encourages teachers to explore new frames, or to ignore them.

Schön's (1988) account of the reflective practicum for teacher education is less than clear itself about the relationship between the practicum and reflection-in-action. His commentaries on the vignettes he offers suggest that the essence of a reflective practicum lies in providing opportunities and support for reflection-on-action even though reflection-in-action is evident in some vignettes. Also, the reflective practicum is designed to help teachers in "giving the kids reason." There is no discussion of the valuative nature of this stance, nor of the possibility that the stance might lead us to miss other matters to which reflective teachers might be attentive.

The work of MacKinnon and Erickson (1988) is germane to this discussion. They use Schön's three coaching models ("follow me," "joint experimentation," and "hall of mirrors") to analyze a supervisory dialogue. The idea that a teacher and supervisor can, together, work at a problem and talk about its reframing is intriguing. Yet it needs to be said that the reframing is not deliberate, and that the work done with the new frame consists of the supervisor and teacher together planning ways to test the new frame. The reflective practicum, then, is an occasion for trying out new frames, but it does not seem to be responsible for the process of reframing itself. When all is said and done, we are still far from understanding how reframing happens. The mystery of how teachers learn to teach "from experience" persists, although our case studies have begun to open up the process.

Research for a Clearer Account

Our view of Schön's contribution is clearly influenced by our interest in how teaching is learned through the interactions between teachers and their experiences. So it is important for us to continue working toward understanding reflection-in-action and reframing. In this section, we consider ways in which research might travel, based on some general characteristics of our own case studies and on some theoretical puzzles.

As we have worked through our case studies of participating teachers, we have observed that some teachers appear more receptive to their experiences than others. (In a way, this reinforces the adage about the difference between having an experience and the way in which an experience is had.) An intriguing characteristic of these teachers is their language: talking about their teaching is not only relatively simple, the language used is both fluid and versatile. Because we have found more examples of reframing among this group, we have begun to consider the impact of having teachers verbalize their thinking. This is also prompted by our participants' reaction to being involved in interviews with our project team. Samples from two cases provide a sense of this:

> Thank you for sending the copy of the case study; you know how I enjoyed talking with you about teaching Grade One. I enjoyed reading the case study just as much. Reflecting on the development of my teaching skills will be helpful for me now as I support teachers who must continually be learning how to teach. Already I have drawn on my experience with you to help me be more understanding and tolerant of a teacher who is still in the "What do I do on Monday?" stage. ["Diane," in a letter to the project team.]

> It's been useful because it makes me sit down and, I guess, verbalize what I'm thinking. I'm always wondering, "What should I do here?" And then we sit down and actually *talk* about it, and things come out that wouldn't normally come out when you're sort of thinking to yourself. ["Jack," in an interview.]

Conceivably, the willingness to acknowledge professional puzzles and an ability to verbalize them are important to reflection-in-action. And it is tempting to think that putting one's thoughts into words is a condition for reflection-in-action. (Certainly, it is a necessary condition for reflection-on-action.) A recent study by Borko, Lalik, and Tomchin (1987) had student teachers make regular journal entries about their teaching experiences. The analysis shows that the written conceptions about successful and unsuccessful teaching were fairly stable over one year, and that there were few differences between the stronger and weaker student teachers. These data suggest that active rehearsal of one's thoughts is *not* a sufficient condition for reflection-in-action. It is not clear that it is even a necessary condition.

Another finding that may be important comes from two cases in which the participants are science teachers (Russell & Munby, in press). The data lead us to wonder if there is a relationship between teachers' views of the nature of science and views of their own professional knowing. Briefly, "Roger" has a well-developed constructivist view of science, and talks easily about the changing character of his own professional knowing; "Wendy" has a "normal" view of science in Kuhn's (1962) sense, and is less able to speak analytically of her own developing competence.

Although such features of our cases are provocative, we remain cautious about pursuing them too vigorously. We are mindful of the dangers of assuming that simple traits offer explanations for variation in complex situations. Studies of teachers' beliefs may be a case in point. As we understand Nespor's (1987) analysis, beliefs are not uniform and uncomplicated: belief systems can influence the definition of problems *and* the selection of information for solving problems (p. 324). Nespor's work suggests that it may be more fruitful to examine the function of beliefs as states that are relevant to particular instances of action, rather than to study them as traits that are relevant to all actions.

One could adopt the view that a focus on states might be productive, but this introduces difficulties too. First, we are mindful of the criticism of Clandinin and Connelly (1988) for the way in which Schön's work is seen as removing the personal biography of an actor from an

analysis of the action. We have no ready answer to this problem, nor to the difficulty of viewing states as constant during action.

The second difficulty with a focus on states is that it suggests that there might be a relatively straightforward link between Schön's theoretical approach and the cognitive science approach, as represented in the work on practical intelligence (Sternberg & Wagner, 1986) and in student and teacher cognitions (Peterson, 1988). At present, we are far from confident in such a link, even though Shulman (1988) finds that Schön's writings and cognitive psychology "have a compatibility that would enrich both were they to acknowledge both the existence and the relevance of the other" (p. 37). The heart of the difficulty is in how one is to represent both reflection-in-action and reframing using the constructs of cognitive science. And even if this is accomplished satisfactorily, one is still faced with the complex task of devising a cognitive model of reframing. Nespor's (1987) analysis of the structure and function of beliefs presents a promising approach to an initial modelling of reflection-in-action and reframing because the language he uses bears some resemblance to the language of Schön's epistemology of practice. An alternative approach is offered by Hills and Gibson (1988), who develop a linguistic conceptual system to account for two of Schön's cases.

Although these approaches appear promising initially, full cognitive modelling of reframing and reflection-in-action may have to wait until we have at least tentative answers to the following questions:

1. What predisposes some teachers to be more open than others to reframing puzzles that arise in their own work, and how does this predisposition change with experience? How do dominant metaphors restrict or contribute to such reflection-in-action and change?
2. What experiences strengthen teachers' abilities to make sense of their own teaching and to utilize theoretical knowledge?
3. What features of professional practice make it puzzling to a teacher? Then, what generates changes and modifications in teachers' practices? And what changes in language accompany changes in teaching?
4. What is the role of language (especially metaphors) in the development of professional knowledge as teachers change their practices? How do metaphors evolve as teachers gain experience with their teaching?

References

Borko, H., Lalik, R. , & Tomchin, E. (1987). Student teachers' understandings of successful and unsuccessful teaching. *Teaching and Teacher Education, 3*(2), 77-90.

Buchmann, M. (1987). Impractical philosophizing about teachers' arguments. *Educational Theory, 37*, 409-411.

Calderhead, J. (1988, April). *Reflective teaching and teacher education.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Clandinin, D. J. and Connelly, F. M. (1986) The reflective practitioner and practitioners' narrative unities. *Canadian Journal of Education*, 11: 184-198.

Clandinin, J., & Connelly, M. (1988, April). *Narrative, experience and the study of curriculum.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Connelly, M., & Clandinin, J. (1986). On narrative method, personal philosophy, and narrative unities in the story of teaching. *Journal of Research in Science Teaching, 23*, 293-310.

Connelly, M., & Clandinin, J. (1988). *Teachers as curriculum planners: Narratives of experience*. New York: Teachers College Press.

Court, D. (1988). "Reflection-in-action": Some definitional problems. In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 143-146). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Fenstermacher, G. (1986). Philosophy of research on teaching: Three aspects. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed.) (pp. 37-49). New York: Macmillan.

Fenstermacher, G. (1988). The place of science and epistemology in Schön's concept of reflective practice. In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 39-46). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Gilliss, G. (1988). Schön's reflective practitioner: A model for teachers? In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 47-53). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Hanson, N. R. (1958). *Patterns of discovery: An inquiry into the conceptual foundations of science*. Cambridge, England: Cambridge University Press.

Hills, J., & Gibson, C. (1988). Reflections on Schön's *The reflective practitioner*. In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 147-175). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Kuhn, T. (1962). *The structure of scientific revolutions*. Chicago: University of Chicago Press.

MacKinnon, A., & Erickson, G. (1988). Taking Schön's ideas to a science teaching practicum. In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 113-137). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Morine-Dershimer, G. (1987). Practical examples of the practical argument: A case in point. *Educational Theory, 37*, 395-407.

Munby, H. (1987). The dubious place of practical arguments and scientific knowledge in the thinking of teachers. *Educational Theory, 37*, 361-368.

Munby, H., & Russell, T., (1989a). Educating the reflective teacher: An essay review of two books by Donald Schön. *Journal of Curriculum Studies, 21*, 71-80.

Munby, H., & Russell, T., (1989b, March). *Metaphor in the study of teachers' professional knowledge*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies, 19*, 317-328.

Olson, P., & Carter, K. (1988, April). *Differences in the knowledge structure and reflective capabilities of cooperating teachers: Implications for the quality of the student teaching*

experience. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Peterson, P. (1988). Teachers' and students' cognitional knowledge for classroom teaching and learning. *Educational Researcher, 17*(5), 5-14.

Russell, T. (1987). Research, practical knowledge, and the conduct of teacher education. *Educational Theory, 37*, 369-375.

Russell, T. (1988, June). *The pressure to cover the curriculum curriculum: A case study of learning to teach.* Paper presented at the annual meeting of the Canadian Society for the Study of Education, Windsor, Ontario.

Russell, T., & Munby, H. (in press). Science as a discipline, science as seen by students, and teachers' professional knowledge. In R. Millar (Ed.), *Doing science: Images of science in science education.* London: Falmer Press.

Russell, T., Munby, H., Spafford, C., & Johnston, P., (1988). Learning the professional knowledge of teaching: Metaphors, puzzles, and the theory-practice relationship. In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 67-90). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action.* New York: Basic Books.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions.* San Francisco: Jossey-Bass.

Schön, D. (1988). Coaching reflective teaching. In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 19-29). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Selman, M. (1988). Schön's gate is square: But is it art? In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 177-192). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-22.

Shulman, L. (1988). The dangers of dichotomous thinking in education. In P. Grimmett & G. Erickson (Eds.). *Reflection in teacher education* (pp. 31-38). Vancouver, BC: Pacific Educational Press & New York: Teachers College Press.

Sternberg, R., & Wagner, R. (Eds.). (1986). *Practical intelligence: The nature and origins of competence in the everyday world.* Cambridge, England: Cambridge University Press.

Toulmin, S. (1953). *The philosophy of science: An introduction.* London: Hutchinson.

Zeichner, K., & Liston, D. (1987). Teaching student teachers to reflect. *Harvard Educational Review, 57*(1), 23-48.